Migration Behaviors and Distribution of Adult Spring Chinook Salmon Radio-Tagged at Willamette Falls Dam in 2011-2014

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  James Bowker (INAD)
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  Robert Wertheimer

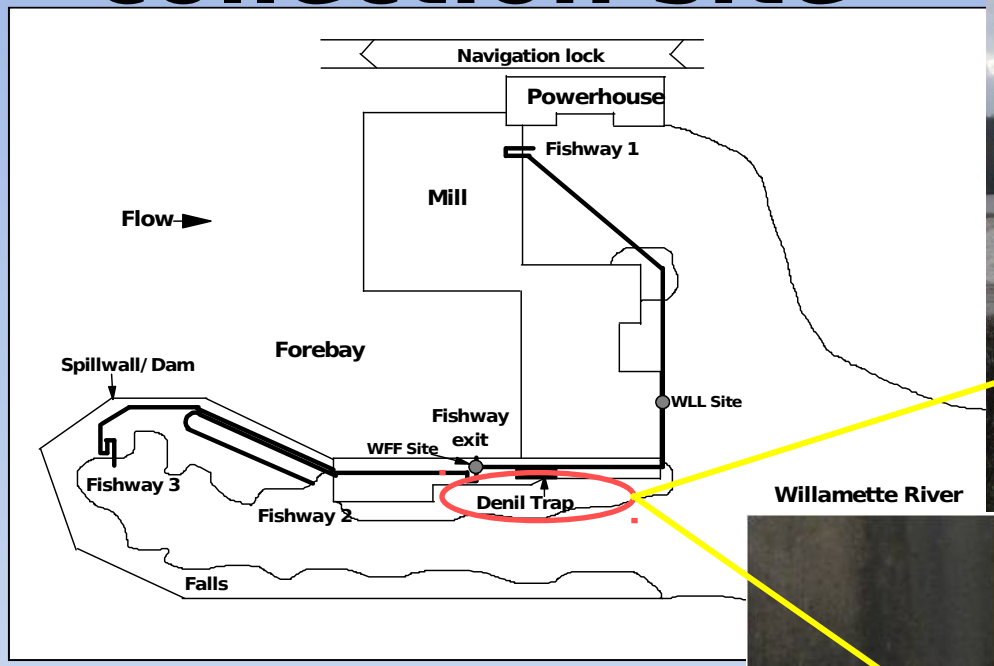
2011-2014 Objectives

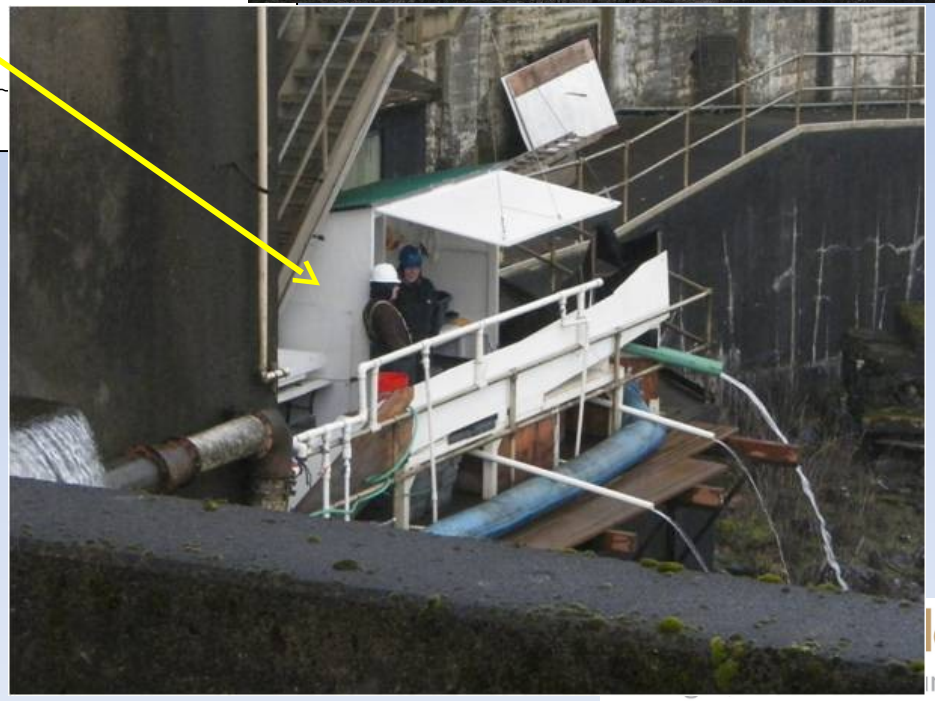
- Characterize salmon behaviors in the main stem & tributaries – ‘Basin Wide Assessment’
  - Migration rates
  - Reach residency times
  - Population-specific migration timing

- Assess distribution / survival
  - Wild vs Hatchery fish
  - Predictors of main stem migration success / mortalit
  - Temperature exposure histor

Temperature has been associated with early mortality in Willamette Chinook

Salmon (and steelhead) collection site



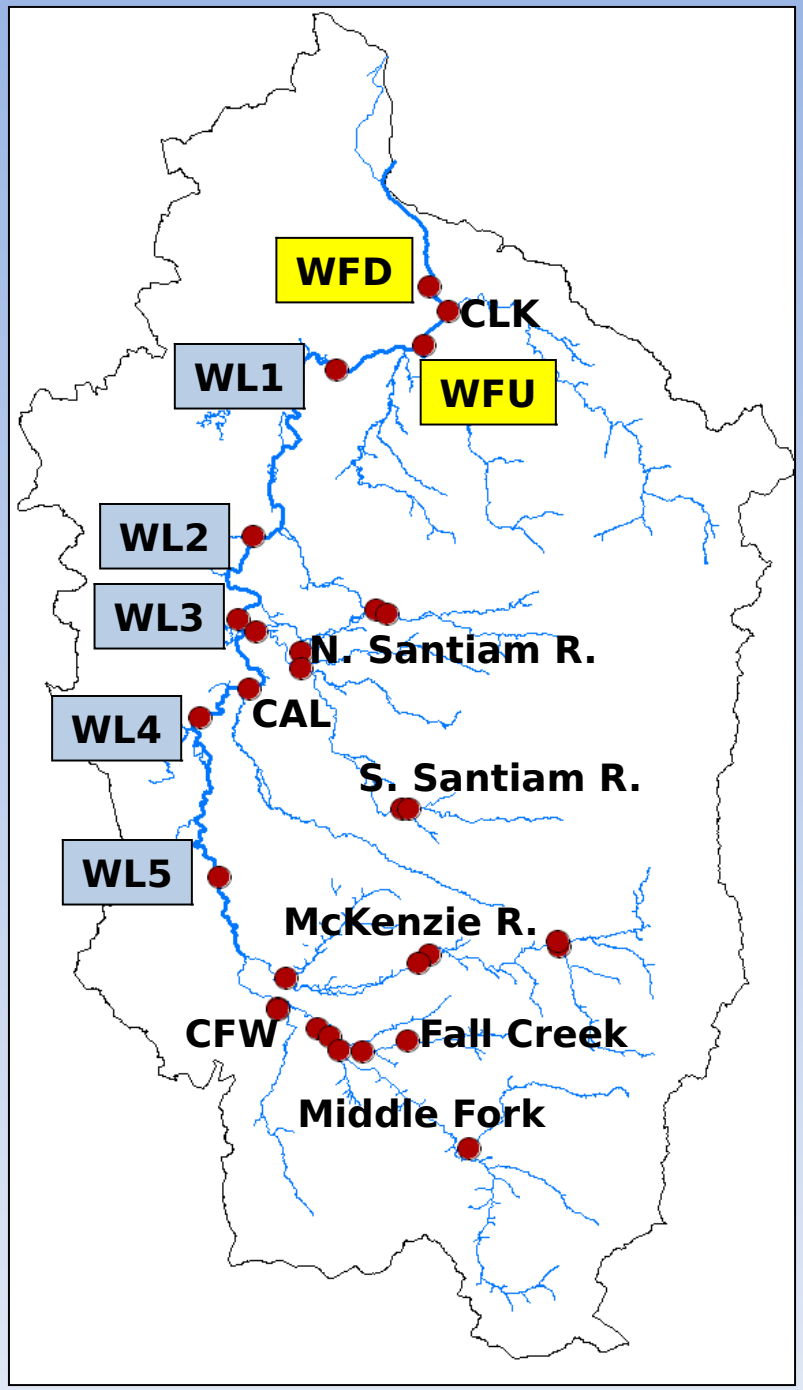


Companion study: winter & summer steelhead: (C. Erdman @ 11:10)

Methods

- Collect using denil trap, conduct rapid non-lethal assessment
- Intragastric radio tag + temperature logger on sub-sample
- Monitor upstream movements and final distribution
  - Recover transmitters & temp loggers (dam traps, hatcheries)

Fixed-site monitoring



Some year-to-year changes in tributary monitoring

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Chinook tagging effort

Year	Number Radio-tagged	Adipose clipped	Adipose intact	Number Restrained	Number Anesthetized	Number Temperature pods
2011	150	112	38	131	19	145 RT + 100 non-RT
2012	500	189	311	346	154	99 RT (ad-clipped)
2013	299	229	70	-	299	66 RT (ad-clipped)

A Field Test of Eugenol-Based Anesthesia versus Fish Restraint in Migrating Adult Chinook Salmon and Steelhead

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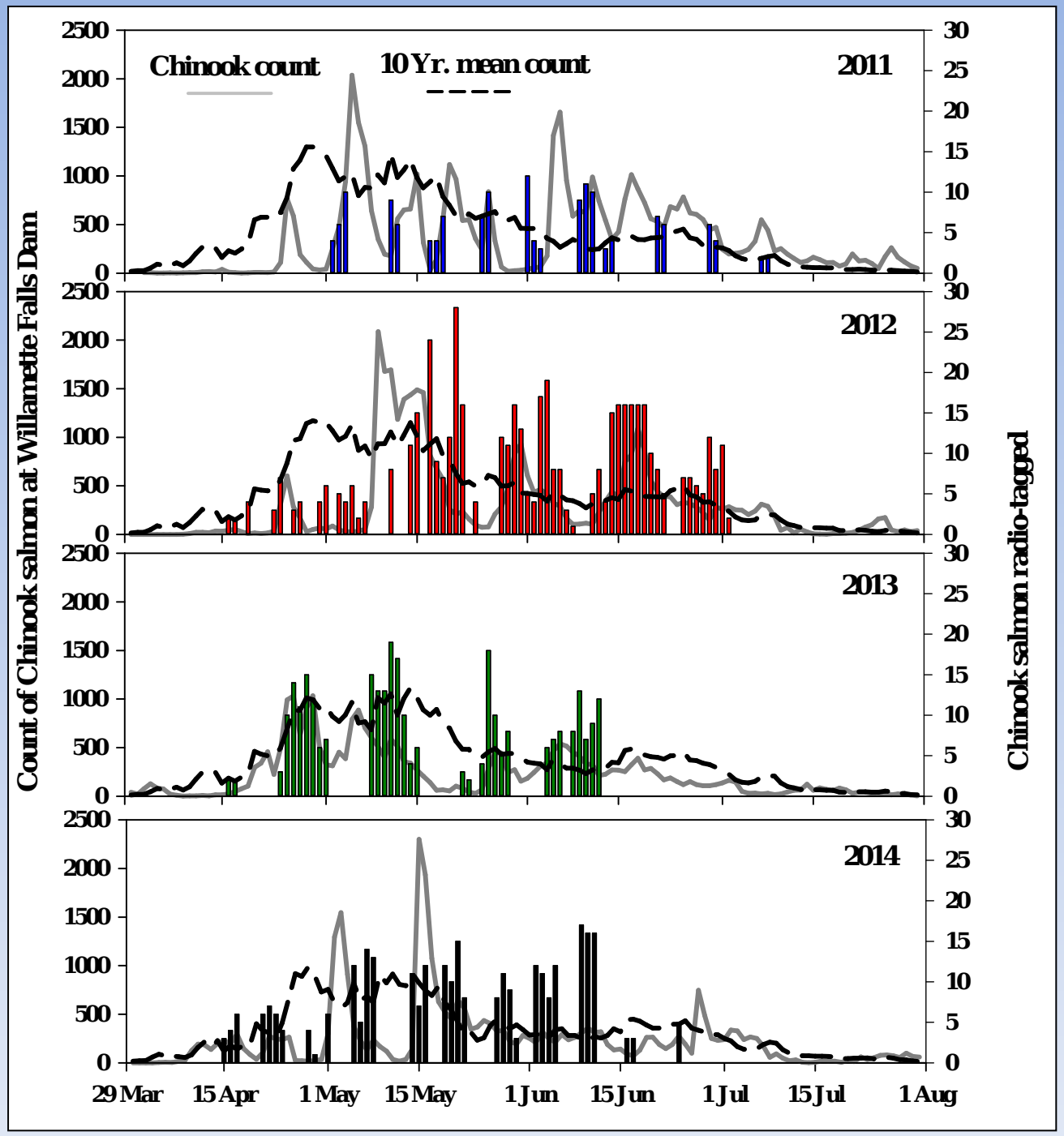
Tagging effort



***n* = 150**

***n* = 500**

2012 included EWEB sample

***n* = 299**

***n* = 300**

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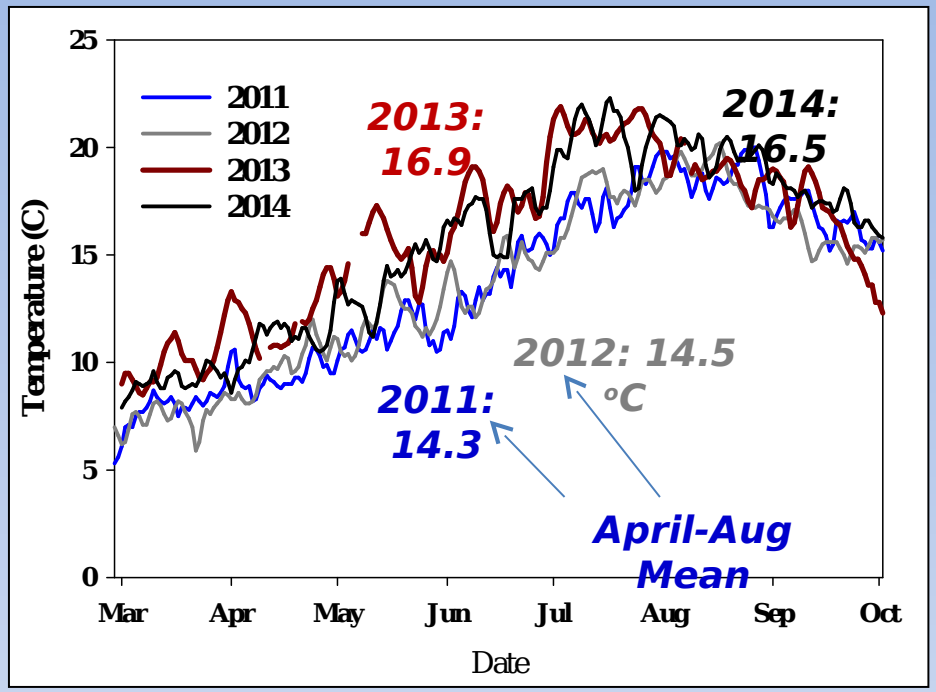
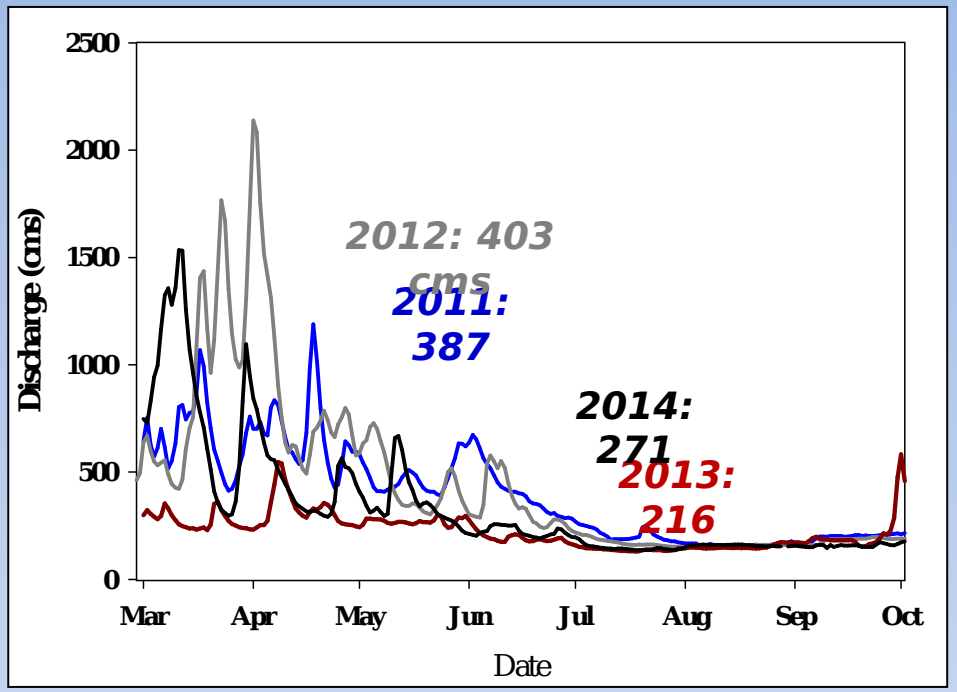
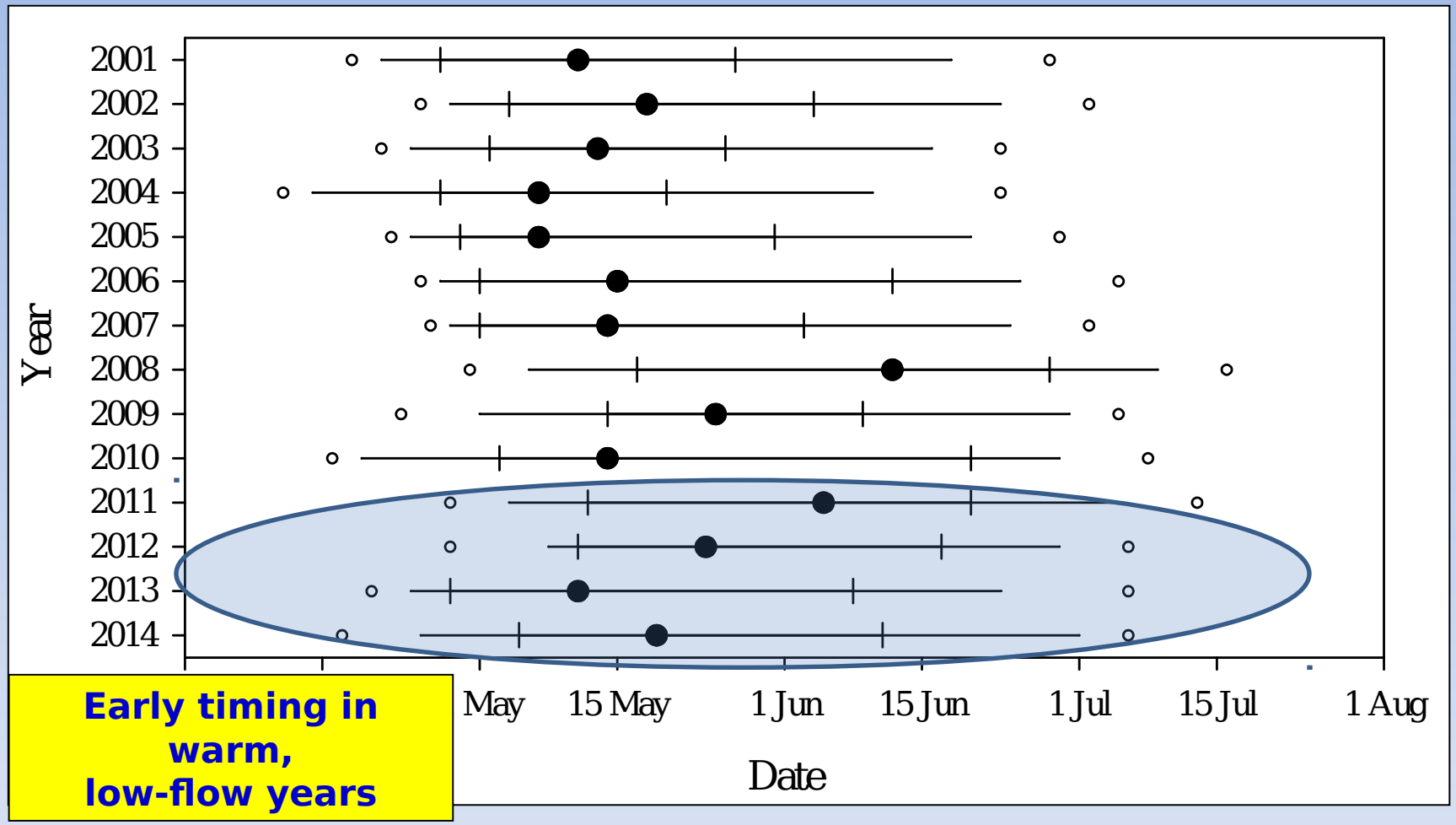
River environment: 2011-2014





Data source = http://ida.water.usgs.gov/ (Albany)

Spring Chinook run timing at Wil Falls



Early timing in warm, low-flow years

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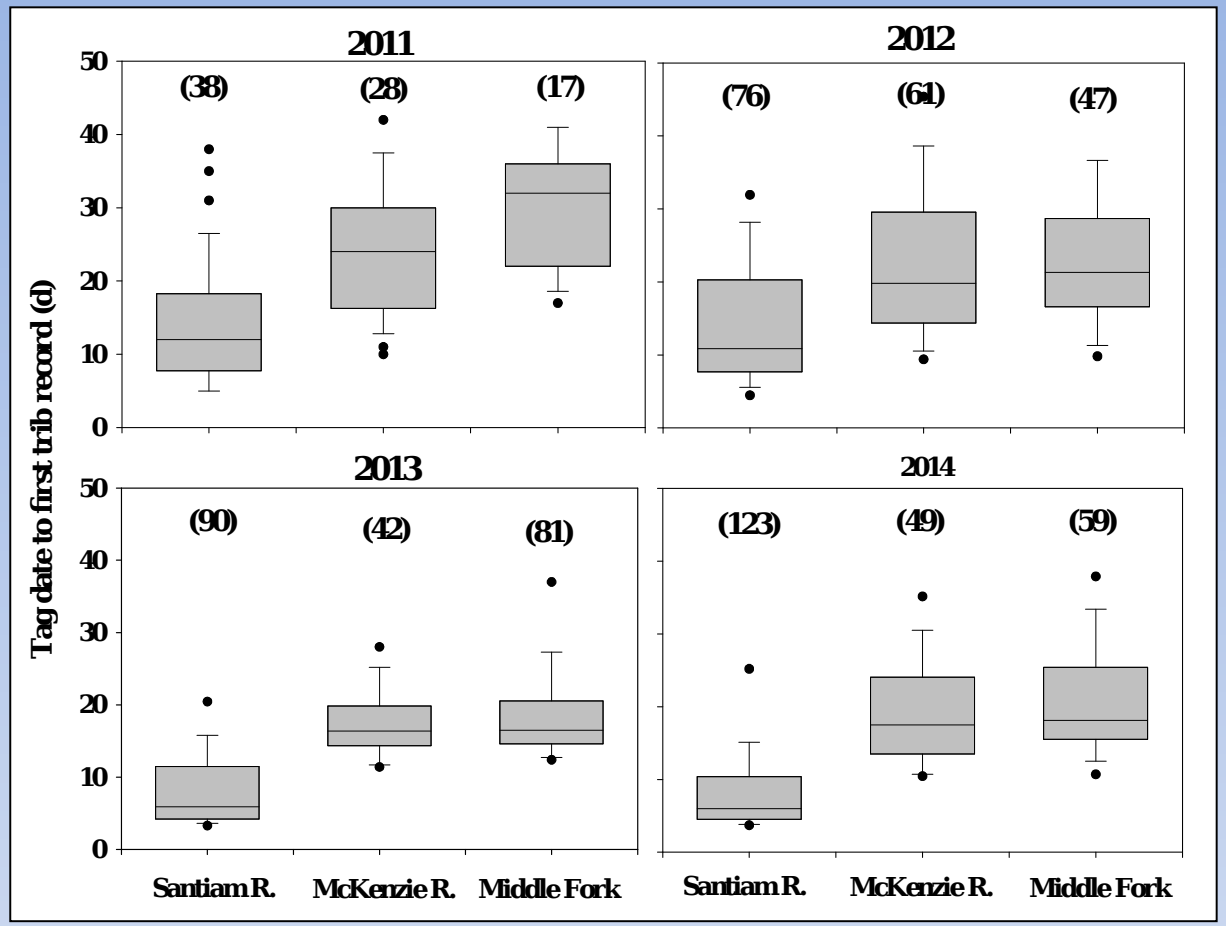
Main stem residency times



Median times (d)

	2011	2012	2013	2014
Santiam	12.0	10.8	5.9	6.0
McKenzie	24.0	19.8	16.4	17.5
Middle	32.0	21.3	16.5	18.1

- **Shorter residence in low-flow, warm years**

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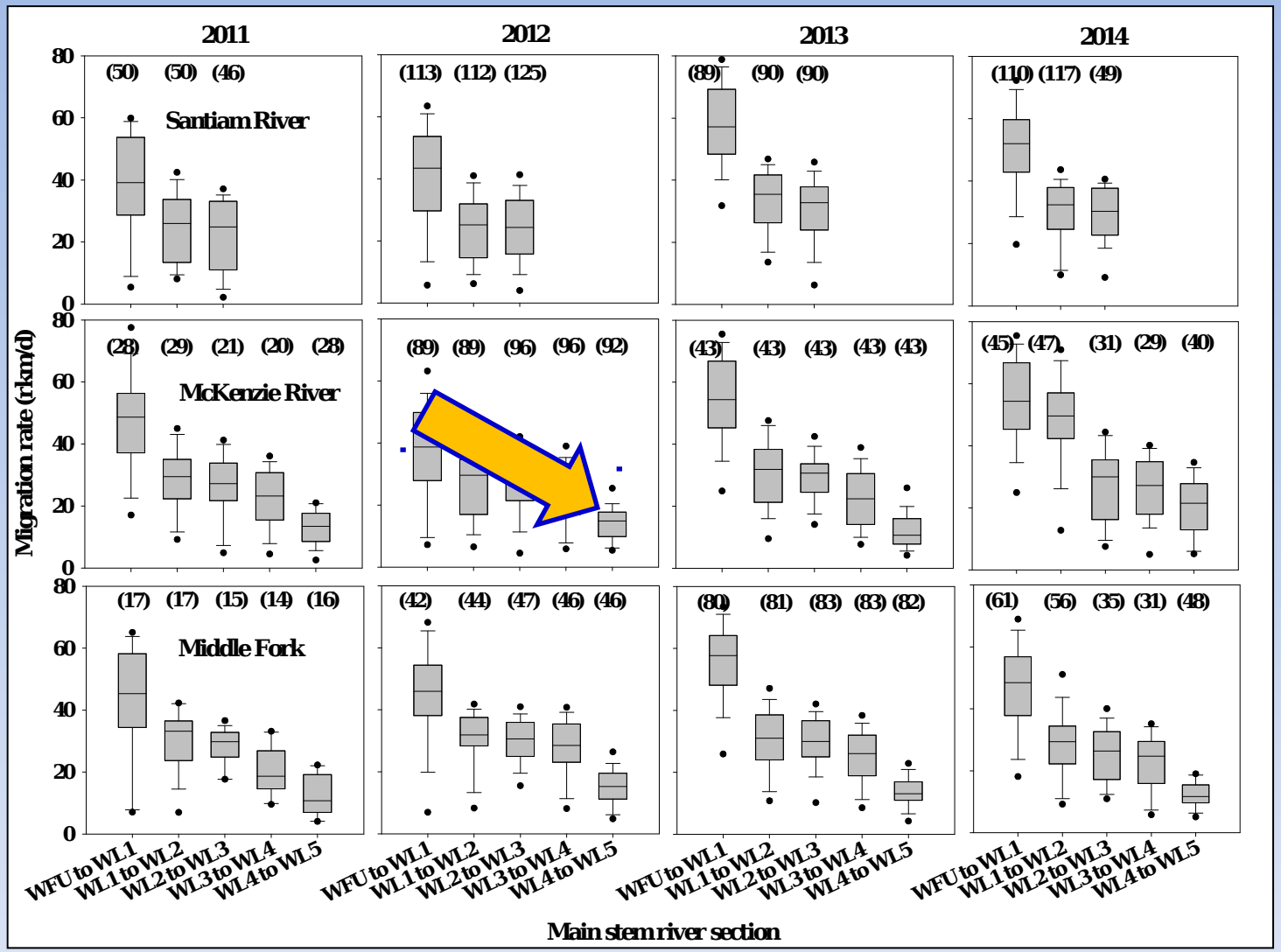
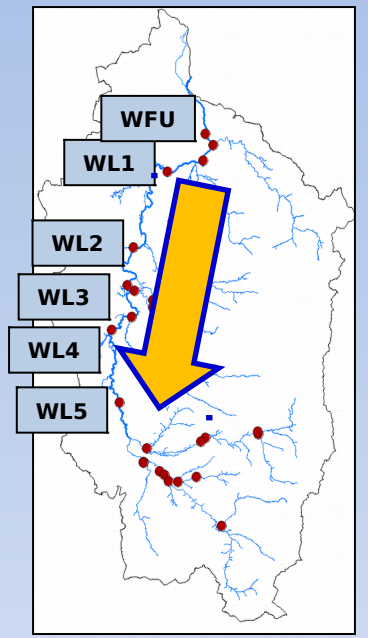
ain stem migration rates – 2011-201





Rapid passage in lower main stem by all populations

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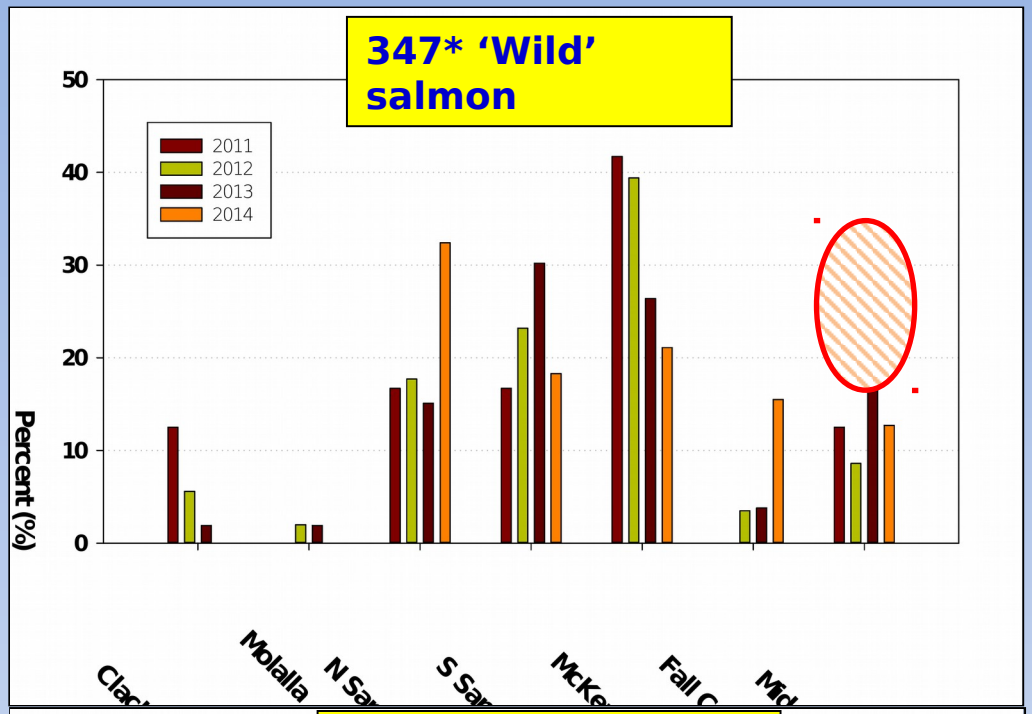
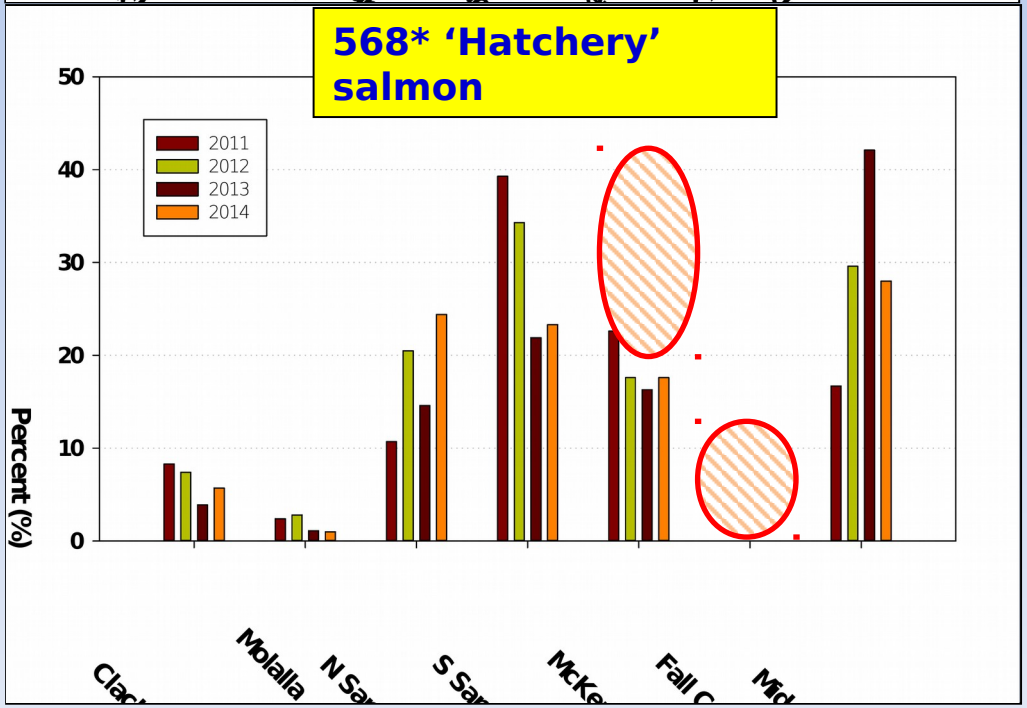
Final Distribution: 2011-2014 fish that escaped to tributaries

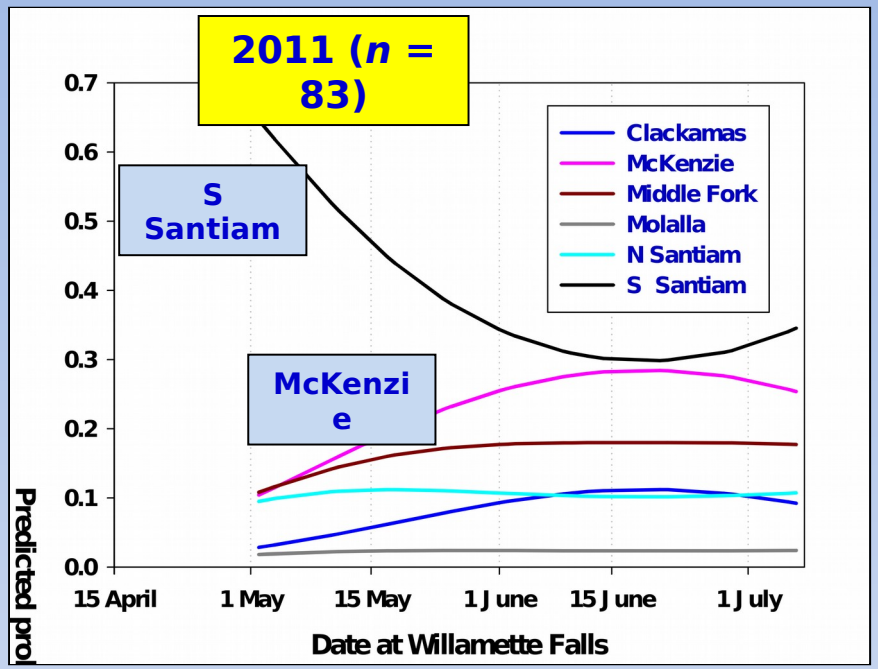
- Modest year-to-year differences *within* origin
- W:H differences in relative abundance
- Includes ‘successful’ fish from both restraint and anesthetic treatments

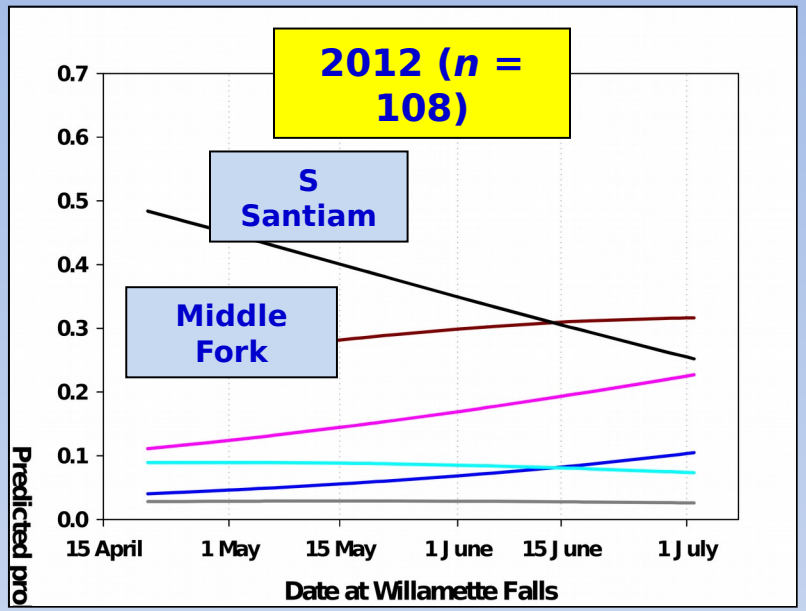




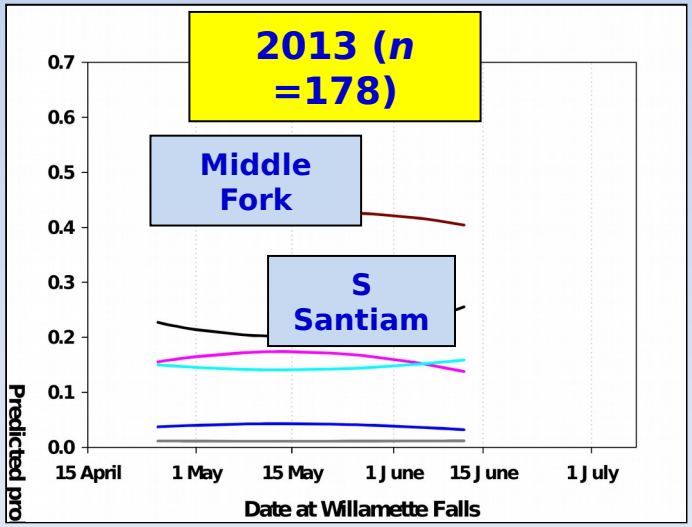
* 6 not shown: main STM, LUK, YAM, CF

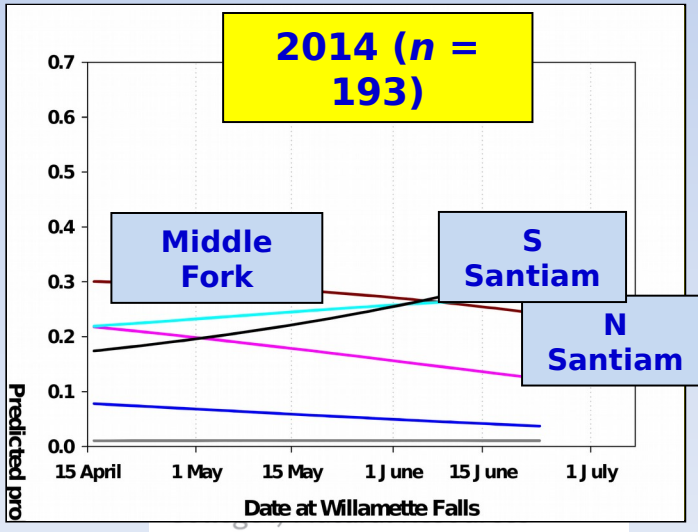
Run Composition: Hatchery Chinook





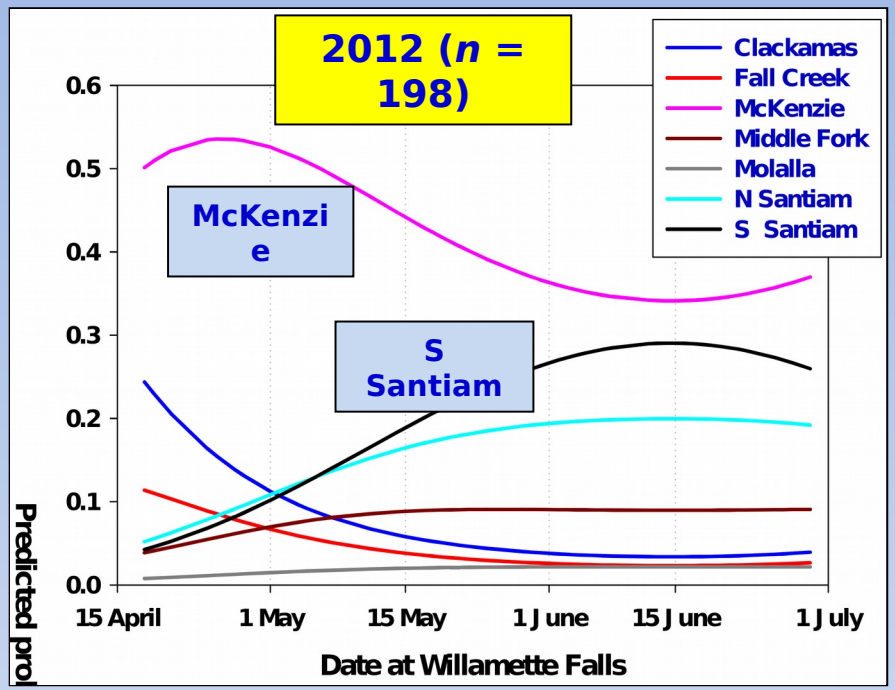
- Generally well-mixed within year
- Relative abundance varies

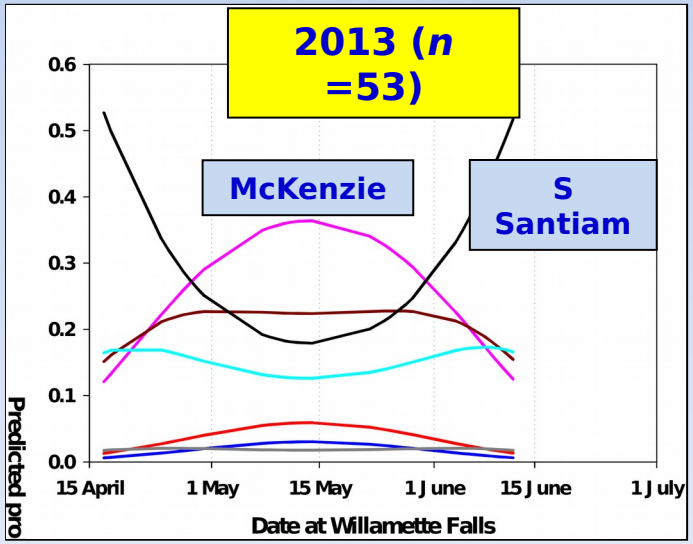


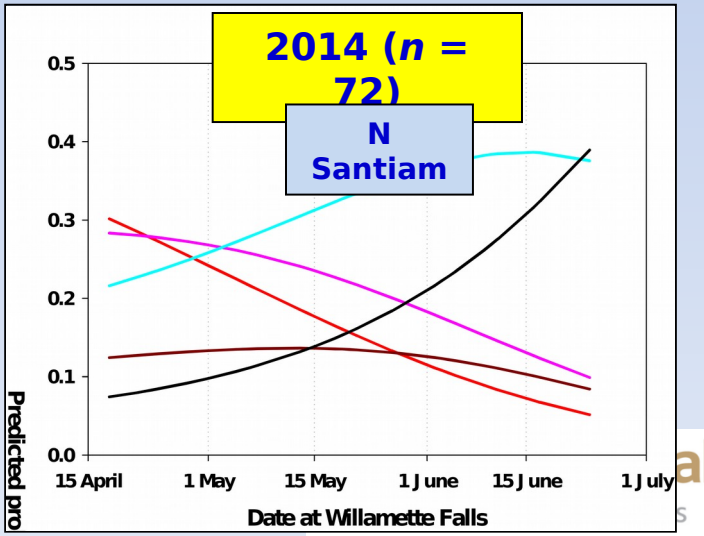


Run Composition: Wild Chinook

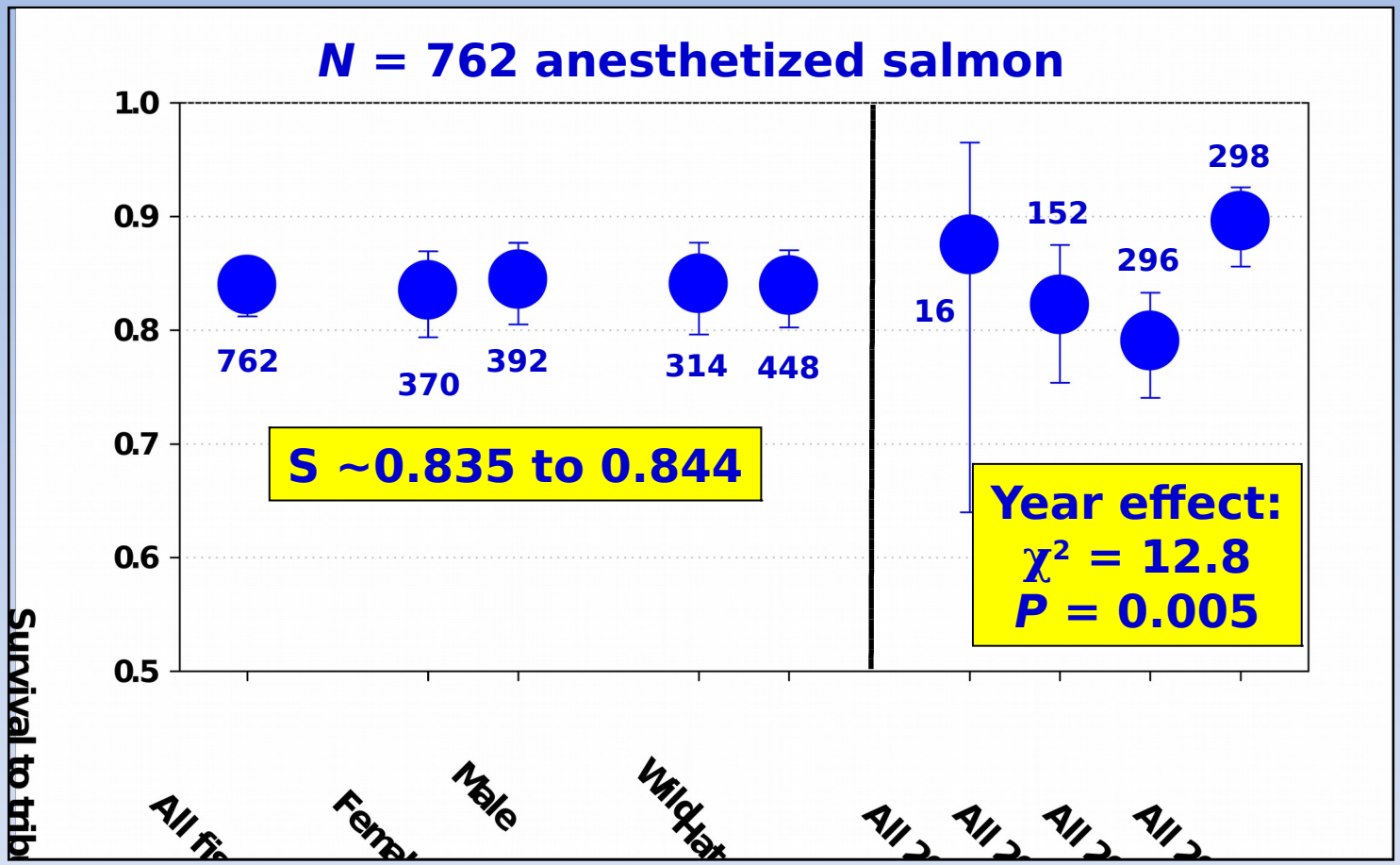
- **Inconsistent patterns; less well-mixed than hatchery groups**







Escapement to Tributaries



Wilson 95% binomial ci's

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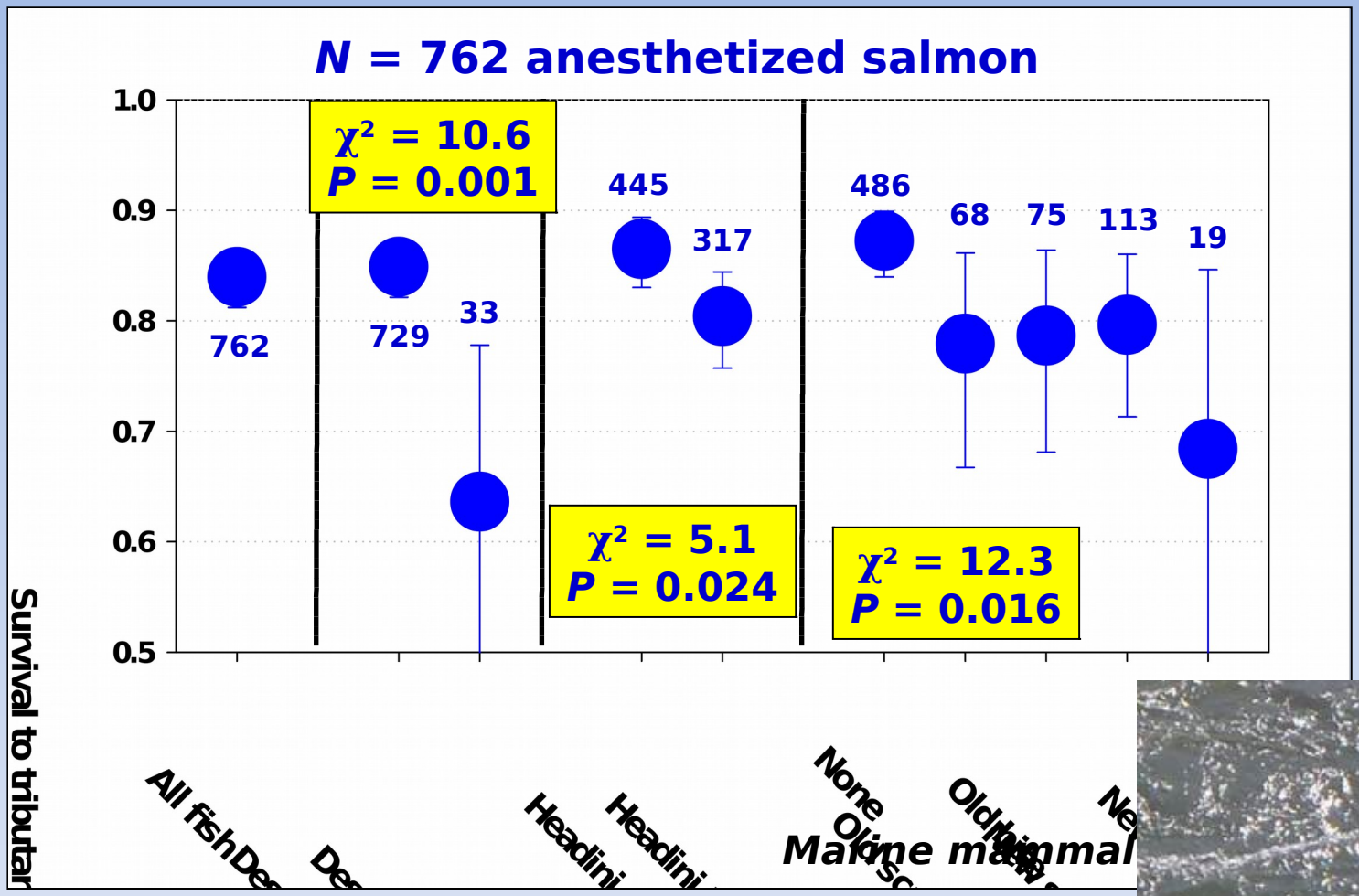
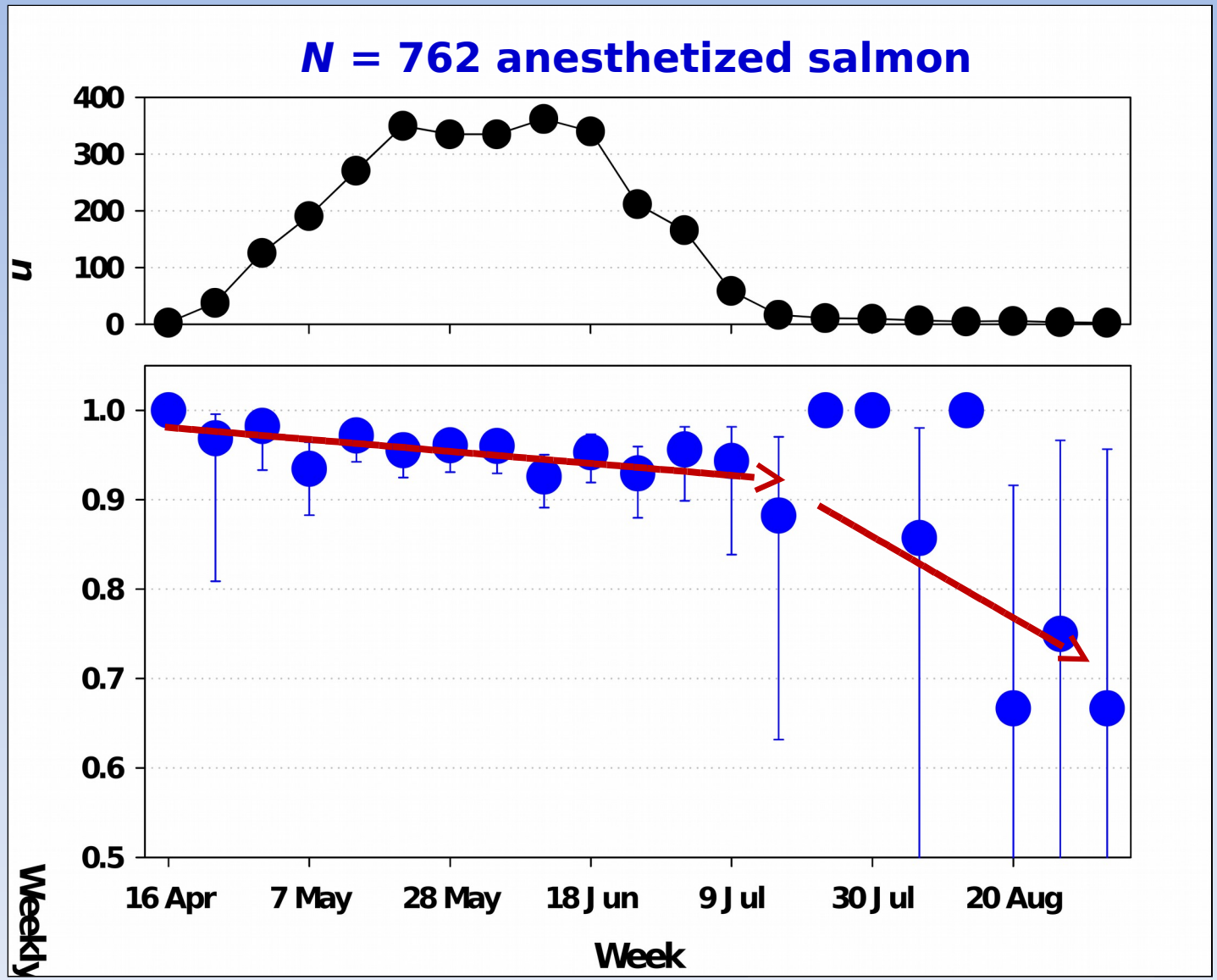
Escapement to Tributaries



Wilson 95% binomial ci's

Weekly main stem survival estimates

- Program MARK ‘known-fate’ model of weekly survival
- Lower survival for migrants in the main stem later in summer as river warms



Weekly main stem survival estimates

Preliminary model comparison: MARK

- **Strong year effect suggests environmental driver**
- **Variety of additional models will be explored**

Model	Parameters	ΔAICc
Year+Descale	5	0.00
Year+HeadInjury	5	2.80
Year	4	3.87
Year+Condition	5	3.88
Year+Sex	5	5.82
Year+Origin	5	5.88
. . . .		
S(.)	1	11.64
Year+Week	24	12.76
Origin	2	13.63
Sex	2	13.64
Week	21	24.24

Previous figure

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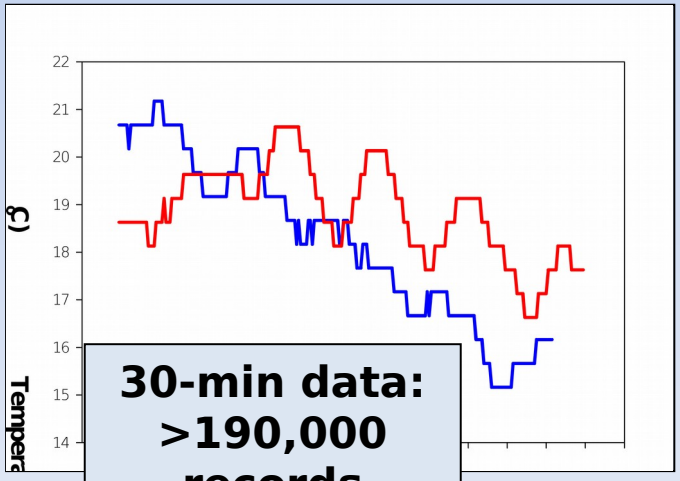
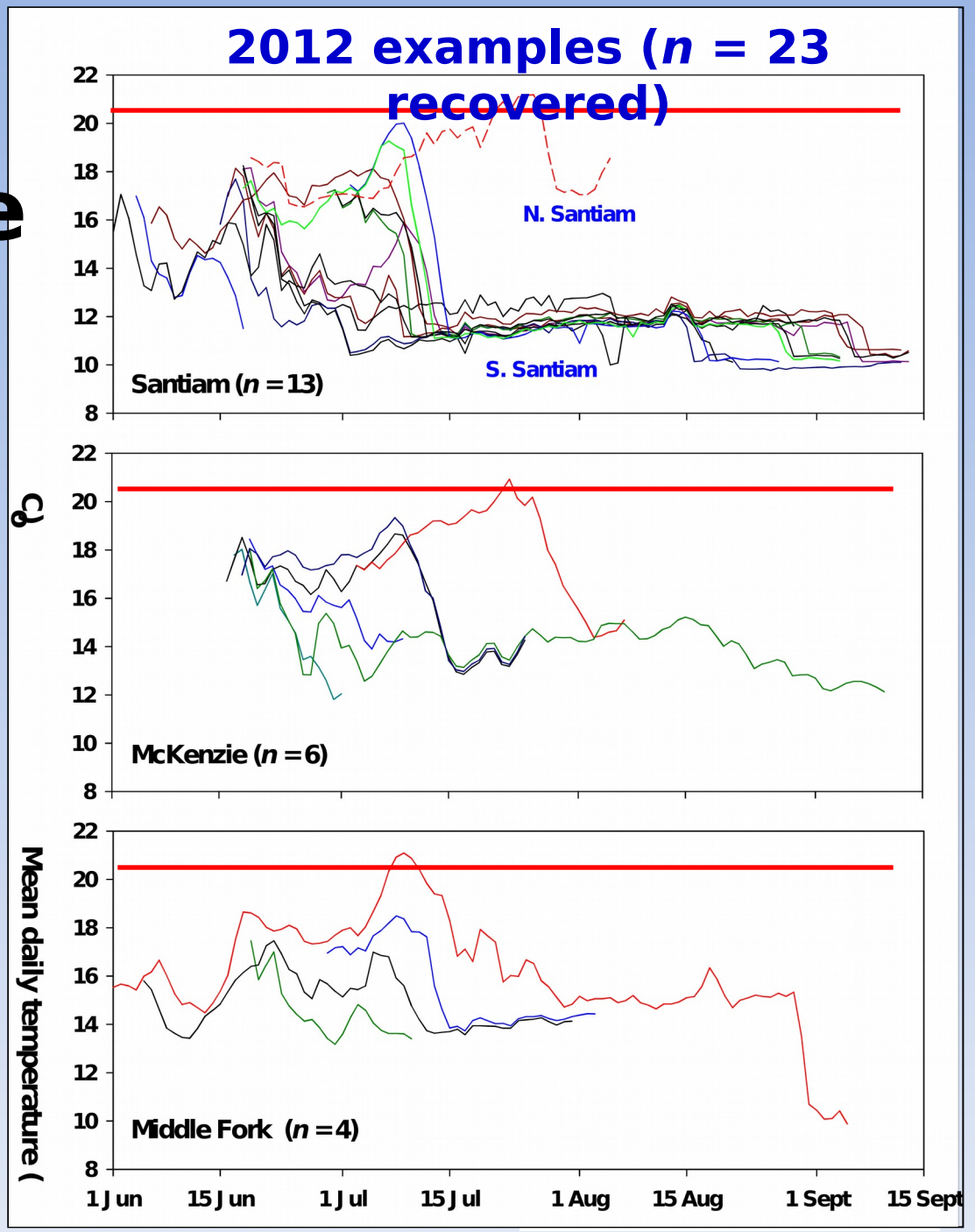
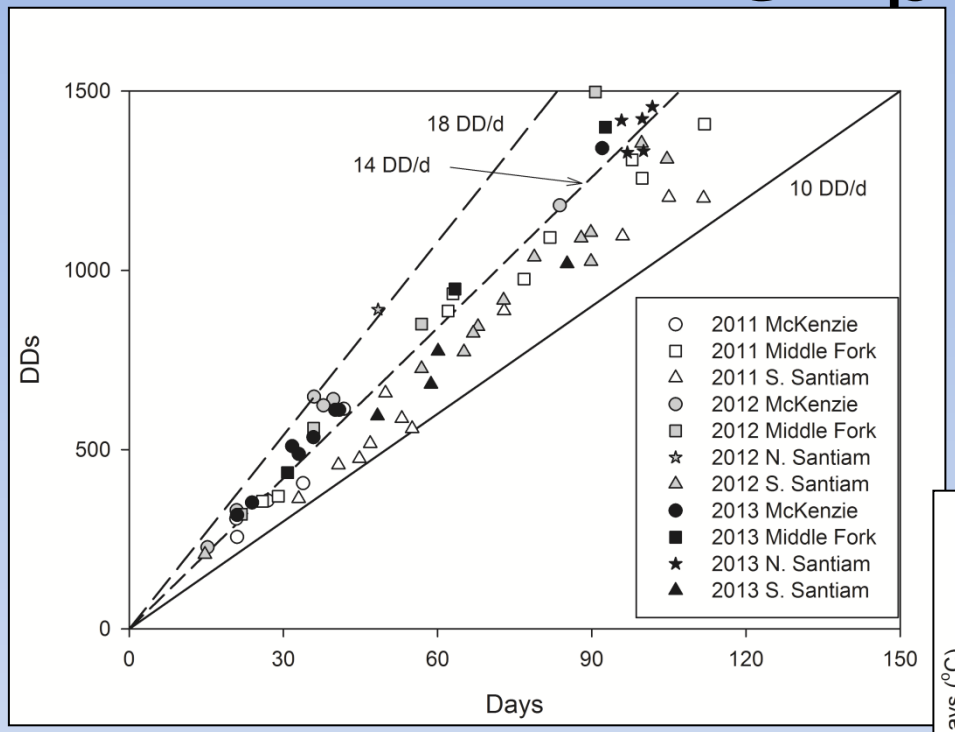
Individual temperature histories



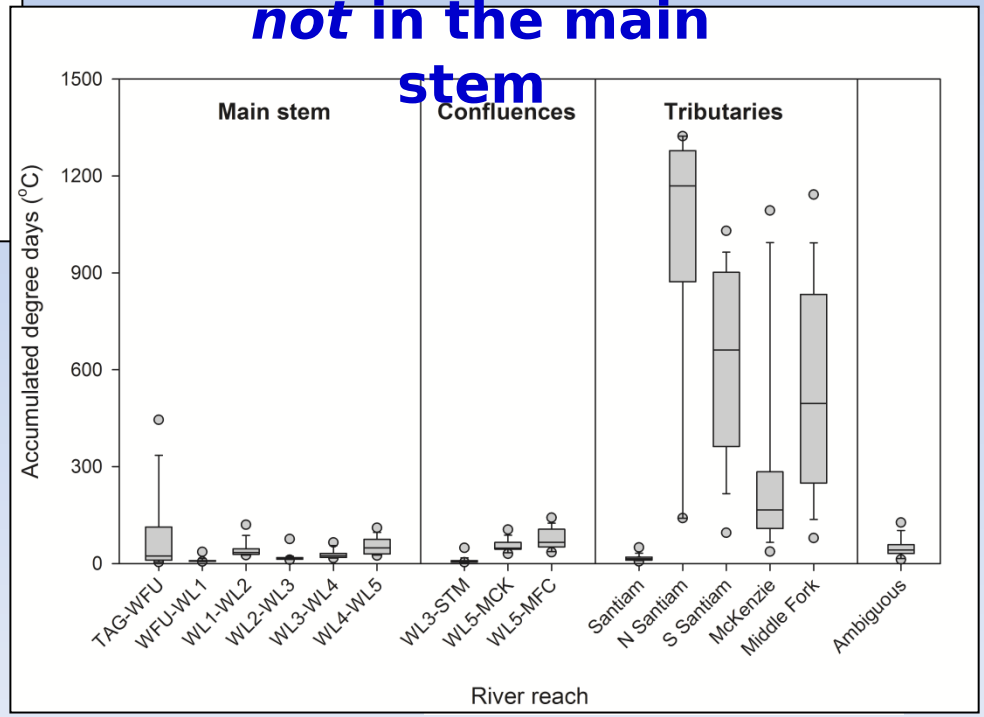
30-min data: >190,000 records



Thermal exposure estimates: 68 temp pods

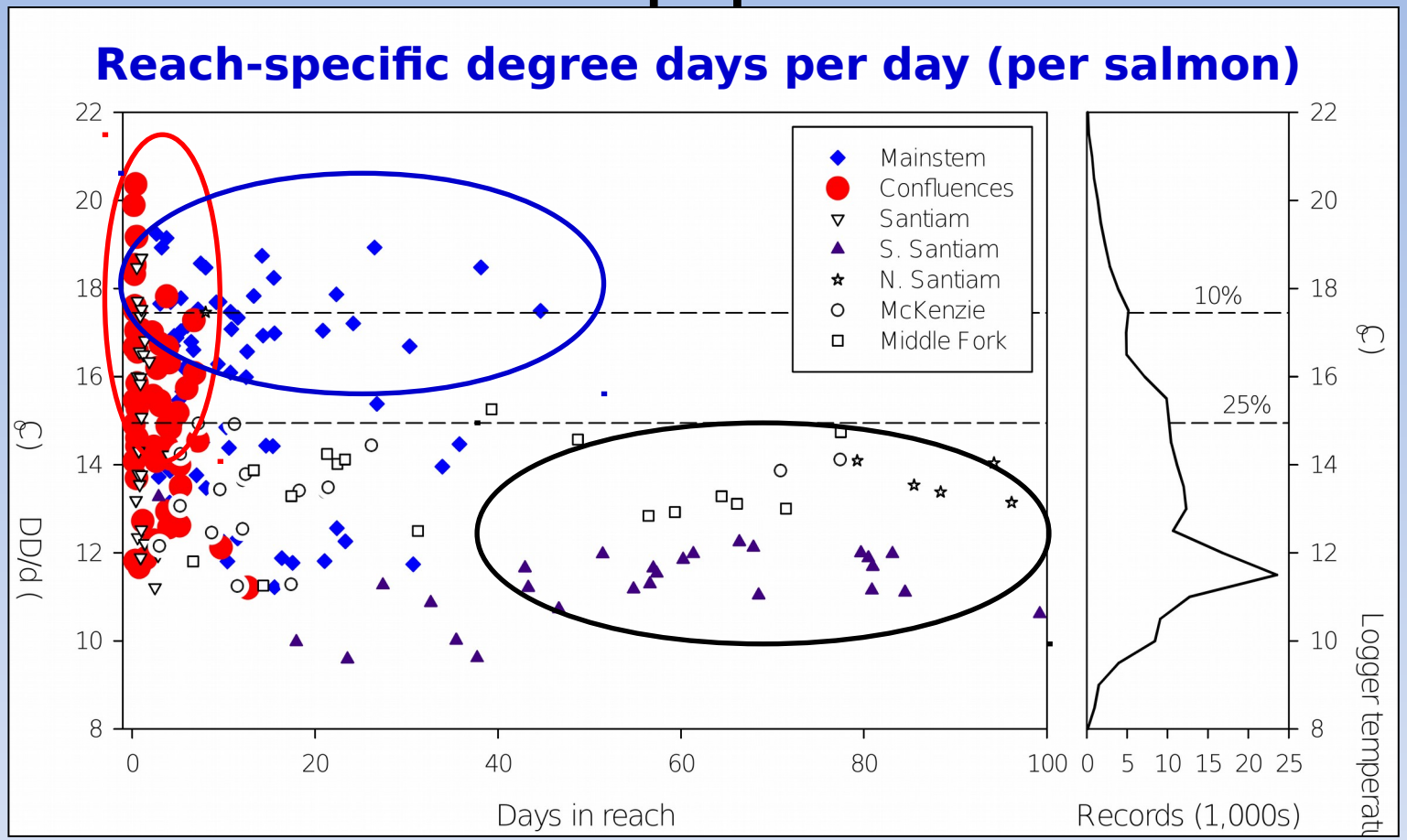


● **Most accumulation in tributary reaches *not* in the main stem**



● **Highly variable days-at-large & total degree day accumulation**

Thermal exposure estimates: 68 temp pods



Thermal exposure of adult Chinook salmon in the Willamette River basin

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J Thermal Biol 48:11-20

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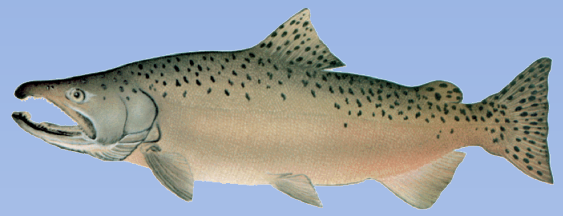
Conclusions



- Improved understanding of main stem experience
- Residency / Transit times ~ 2-5 weeks in main stem
- Migration rates ~ 10-60 km/d in main stem
  - Variable, fastest downstream from Salem
- Populations fairly well-mixed through time
  - Wild composition more variable within-year
- Escapement to tributaries ~ 79-90% (Eugenol fish)
  - Descaling, head injuries, marine mammal injuries
  - Lowest survival in warmest year (2013)
  - Survival declines as season progresses
  - Escapement <> Reproductive Success

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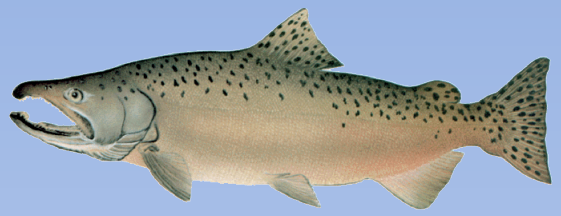
Conclusions



- Temperature exposure varies among years, reaches
- Lower main stem reaches warmest for most fish
- Degree-day accumulations highly variable
- Short-duration stressful exposure was common
- L… …ne
  b… …m
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Questions?

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